MULTICOMPONENT ASSESSMENT AND TREATMENT OF CIGARETTE PICA

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL OF
THE UNIVERSITY OF FLORIDA
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1997

ACKNOWLEDGEMENTS

I wish to express my gratitude to all who have helped make this study possible. Thanks go to Dr. Brian A. Iwata, my committee chair and major professor, for his invaluable assistance throughout the study and, more generally throughout my years in graduate school, for his tireless endeavor in shaping my professional and nonprofessional repertoire. Appreciation is also extended to Drs. Marc Branch, Timothy Hackenberg, Alan Spector, and Stephen Golant for serving on my committee.

I also acknowledge my fellow graduate students, SungWoo Kahng, Dorothea Lerman, Bridget Shore, Sonya Fischer, Jana Lindberg, Michele Wallace, Iser DeLeon, and Juliet Burke, who served as therapists and/or observers during various times of the study. Special thanks go to Bridget Shore who provided insightful comments regarding conceptual issues of the study.

Finally, I am deeply appreciative of the continual love, respect, and support provided by my parents, Kong Chuan and Florence, and my brothers Han Lin and Han Hsiung.

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December, 1997

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Pica, a behavior disorder common among individuals with developmental disabilities, is defined as the ingestion of nonedible substances. It is a form of self-injurious behavior due to substantial health risks posed to those exhibiting pica. One topography of pica involves the ingestion of cigarette products. Few studies have focused on the treatment of cigarette pica, and attempts to identify factors responsible for the maintenance of pica have been rare. Thus, the purpose of the study was to demonstrate a methodology for the assessment and treatment of cigarette pica.

Four individuals with developmental disabilities participated. Assessment procedures were conducted in three distinct phases. First, preference for cigarette components was assessed to identify the specific reinforcing component of the cigarette. Second, preference for edible or leisure items was assessed to identify possible potent alternative reinforcers that may be used during treatment. Third, preference between cigarette and noncigarette stimuli was assessed to determine if the alternative reinforcer could compete effectively with cigarettes and, thus, may be used in reinforcement-based treatment procedures to eliminate pica. Results indicated that stimulus preference assessments were

successful in identifying the reinforcing component of the cigarette, and in identifying alternative reinforcers, and suggested the feasibility of using alternative reinforcers during treatment to eliminate cigarette pica.

The effectiveness of two treatment procedures was evaluated. Noncontingent reinforcement with the alternative reinforcer was found to be effective at dense schedules for two of the participants, but initial treatment effects failed to maintain during schedule thinning. Differential reinforcement of an alternative behavior with the alternative reinforcer was effective in deterring pica for three participants. An evaluation of 10 treatment procedures failed to identify an effective intervention for the remaining participant; consequently, preventive measures were designed to minimize occurrences of cigarette pica. Noteworthy contributions as well as limitations of the study are discussed, along with future directions for research.

INTRODUCTION

Pica is defined as the ingestion of inedible substances (Gutelius, Millican, Layman, Cohen, & Dublin, 1962). Although many topographies of pica have been reported in the literature, all can be categorized as either (a) nondiscriminant, in which individuals ingest a variety of objects such as strings, rags, paper, leaves, grass, metal, glass, plastic, wood, toiletries, hair, nails, insects, and paint; or (b) specific to certain classes of stimuli, such as ingestion of feces (coprophagia); soil, floor dirt, sand, and rocks (geophagia); or cigarette products (Danford & Huber, 1982). Danford and Huber (1982) conducted a survey over a 2-year period among a population of 991 institutionalized residents diagnosed with mental retardation and found the prevalence of pica to be approximately 16.7%. Similar results were reported in a more recent survey in which the prevalence of pica was found to be approximately 15.5% among a sample of 806 individuals (Lofts, Schroeder, & Maier, 1990). Thus, pica is a relatively common behavior disorder, and the present study describes a multicomponent approach to its assessment and treatment.

Pica poses two problems that warrant treatment. The primary concern is that pica is considered a form of self-injurious behavior due to the potential for physical harm such as lead poisoning (Finney, Russo, & Cataldo, 1982), intestinal blockage (Albin, 1977), and parasitic infestation (Foxx & Martin, 1975). A secondary concern is that ingestion of inedible substances is not considered socially appropriate; this is especially true for certain topographies of pica, namely coprophagia, which involves ingestion of bodily wastes. Furthermore, socially offensive response products may be evident, such as odor and the

presence of feces around the mouth, fingernails, and other parts of the body (Foxx & Martin, 1975). Thus, pica can be an inherently dangerous behavior and, if not, may nevertheless pose a barrier to social integration.

One theory concerning etiology suggests that individuals who engage in pica are nutritionally deficient (Danford, Smith, Jr., & Huber, 1982). Studies have found that individuals who engaged in pica also were deficient in specific minerals such as iron (Crosby, 1971; Moore & Sears, 1994), zinc, copper, magnesium, (Cavdar & Arcasoy, 1972), and vitamin B components (Bugle & Rubin, 1993). Most of these studies did not conduct experimental manipulations to determine if nutritional deficiency was the cause of or an effect of pica. Two notable exceptions were the Bugle and Rubin (1993) and Gutelius et al. (1962) studies. Bugle and Rubin (1993) found that increasing the supplemental intake of vitamin B components resulted in a decreased level of pica, providing some support for the hypothesis that nutritional deficiency was the basis for pica. On the other hand, Gutelius et al. (1962) found that although individuals with pica were iron-deficient, the behavior was equally suppressed among two groups of individuals: those who received saline injections, and those who received injections with iron supplements. Thus, because differential improvement was not evident in the two groups, the findings did not support the theory of nutritional deficiency as the etiological basis for pica; instead, it is possible that other factors were responsible for behavioral maintenance and that nutritional deficiency was a result of pica.

Danford, Smith, Jr., and Huber (1982) hypothesized that nutritional deficiency was not the etiological basis for pica but, instead, occurred as a result of the behavior. That is, ingestion of certain objects may cause a chemical reaction (i.e., binding effect) or chelation with certain minerals that may result in deficiency of those minerals. In other words, they posited that nutritional deficiency may not

be a feasible etiological account of pica and that the cause of pica remains to be identified. They analyzed blood, plasma, and hair samples for a group of 60 individuals who engaged in pica versus a control group of 60 individuals who did not engage in the behavior and measured concentration levels of minerals such as iron, zinc, copper, and magnesium in both groups. Their findings indicated that plasma iron and zinc concentrations were markedly lower in individuals who engaged in pica relative to those who did not. However, because no experimental manipulations were conducted, their results only suggested a correlation between individuals who engage in pica and low concentrations of certain minerals. As they stated, a definitive illustration that mineral deficiency is caused by pica has yet to be made. Nevertheless, given mixed findings from the Gutelius et al. (1962) and Bugle and Rubin (1993) studies, and lack of further supporting evidence, it appears that the theory of nutritional deficiency as a possible etiological basis for pica is not well substantiated.

A second theory that has not received much attention in the literature is the possibility that pica may be maintained by social consequences. Given the potential for physical harm as a result of pica, it would seem that immediate attention (e.g., reprimands, attempts to remove ingested objects, or implementation of emergency medical procedures) would often be delivered as a consequence to certain forms of pica. Alternatively, pica may be a highly effective escape response during instructional activity if it terminates the task at hand. Thus, pica may serve as either an attention-seeking response or as an escape response. To date, however, no studies have provided evidence indicating that pica is maintained by social consequences.

A common feature of the two theories is that pica is viewed as learned behavior maintained by consequences. The theory of nutritional deficiency is a

biological theory suggesting that pica is maintained by specific stimulus characteristics that are directly produced by ingestion of inedible objects (i.e., it does not involve mediation through the action of others). That is, the behavior seems to produce its own reinforcing consequences; hence the term "automatic reinforcement" (Vaughan & Michael, 1982) would seem to apply when describing the general class of reinforcement contingencies that maintain pica. By contrast, the second theory emphasizes behavioral maintenance as a function of social reinforcement. Thus, theories on pica can be differentiated on the basis of automatic versus social reinforcement as the general class of maintaining contingency.

Because no published research has investigated social reinforcement as the etiological basis of pica, the emphasis has solely been on the automatically reinforced nature of the behavior. One implication of these studies (Bugle & Rubin, 1993; Cavdar & Arcasoy, 1972; Crosby, 1971; Moore & Sears, 1994) is that individuals who engage in pica have learned to ingest specific inedible substances (i.e., they were able to discriminate among types of inedible objects) in order to obtain needed nutrients or to restrict the intake of those nutrients (Danford, Smith, Jr., & Huber, 1982). Hence, it is possible that the basis for learned discrimination may be specific reinforcing consequences produced from ingesting particular stimuli. For example, an individual may ingest only clay because it provides gustatory reinforcement. Thus, given the assumption that pica is automatically reinforced, it may be possible to systematically identify the specific reinforcer of the behavior. Only two studies (Favell, McGimsey, & Schell, 1982; Mace & Knight, 1986) have attempted such an investigation.

Favell et al. (1982) evaluated the effectiveness of continuous access to alternative sources of reinforcement in a series of 3 experiments for six individuals with developmental disabilities who exhibited various topographies

of SIB, three of whom engaged exclusively in pica. In one experiment, the 3 participants were allowed free access to toys, popcorn, or both toys and popcorn, to determine if alternative sources of reinforcement would effectively compete with pica, which was defined as ingestion of clothing and small pieces of inedible objects. Results showed that pica was equally suppressed compared to baseline, in which alternative sources of reinforcement were unavailable, when either toys or popcorn were freely available. Additionally the concurrent availability of both toys and popcorn did not result in differential effectiveness when compared to either one presented alone. The authors also observed an inverse relationship between the level of toy chewing and that of pica, indicating that the replacement behavior (toy chewing) effectively substituted for the target behavior. Thus, the results suggested that (a) the replacement topographies for pica (i.e., toy chewing and ingestion of popcorn) may suggest that oral stimulation or gustatory reinforcement were the specific maintaining reinforcers, and (b) providing continuous access to alternative sources of reinforcement may be an effective treatment for pica. However, as the authors noted, conclusions regarding the behavior's maintaining reinforcer were preliminary because the assessment methodology used was an indirect one. That is, the methodology involved continuous access to alternative sources of reinforcement, and conclusions were based on the extent to which replacement topographies competed with pica (i.e., the maintaining reinforcer was inferred based on the extent to which near elimination of pica was observed concurrently with high levels of toy chewing and ingestion of popcorn). A direct means of identifying the maintaining reinforcer, which was not conducted in the study, would be to modify some stimulus characteristics of the pica objects to see if such manipulations would alter the frequency of pica.

Mace and Knight (1986) analyzed the relationships between environmental variables and pica. The participant's (Jim) pica was defined as ingestion of clothing and other materials that could be ripped or shredded and wedged between his face and the shield of a helmet, which was worn to minimize occurrences of the target behavior. Prior to conducting a functional analysis of environmental variables purported to influence pica, a baseline condition was designed. The purpose of the baseline condition was to provide a basis from which to select specific environmental variables that would be systematically manipulated during the functional analysis. The procedures during the baseline condition were those that were occurring naturally in the classroom. That is, the teacher provided Jim with instructions to engage in a task; once initial instructions were delivered, the teacher provided attention intermittently (i.e., on a variable time or VT 8 min schedule, in which time-based delivery of attention occurred on the average of every 8 minutes) to all students in the classroom. Contingent on pica, the teacher delivered mild reprimands while removing objects from Jim's mouth.

The functional analysis was conducted in two phases. Phase 1 was designed to determine the effects of noncontingent social interaction on pica. Throughout all three conditions of Phase 1, Jim wore the helmet with the face shield. In two conditions, social interaction was delivered independent of the occurrence of pica on time-based schedules that ranged from VT 15 s (frequent-interaction condition) to once every 3 minutes (limited-interaction condition), whereas no social interaction was provided in the no-interaction condition. Phase 2 was designed to examine the effectiveness of varying levels of protective equipment on pica. Procedures during all three conditions were similar to those of the limited interaction phase, with the exception that each condition differed with respect to the level of protective equipment used. During the helmet with face

shield condition, a helmet identical to the one worn during Phase 1 was used; during the helmet without face shield condition, a similar helmet was worn without the face shield; and, during the no helmet condition, no protective equipment was worn.

Results of the analyses of the social interaction and protective equipment conditions indicated that, compared to baseline, the greatest level of response suppression was evident in the frequent interaction and no helmet conditions. Based on these results, Mace and Knight (1986) sought to identify whether the two conditions (frequent interaction and no helmet) were functionally related to each other in suppressing pica. They hypothesized that due to the lack of protective equipment (no helmet condition), staff needed to closely supervise and protect Jim from engaging in pica and, as a result of close staff supervision, reprimands were delivered for a high proportion of pica responses (i.e., reprimands may have served as punishment)(frequent interaction condition). Data relevant to this hypothesis were collected under naturalistic conditions. The results indicated that staff interacted more often with Jim, and that pica-contingent reprimands were higher when the helmet was not worn than when it was worn, suggesting that Jim was able to discriminate situations in which he could and could not engage in pica (i.e., the absence of the helmet with the face shield likely was correlated with higher probabilities of punishment such that a relatively lower level of pica occurred under that condition). Thus, the study illustrated the use of a functional analysis to identify environmental stimuli that were reliably correlated with different levels of pica. However, due to the possibility that social interaction could have served a <u>punishment</u> effect, the study did not identify the specific maintaining <u>reinforcer</u> of pica. Nevertheless, the methodology used by Mace and Knight did rule out one potential source of reinforcement: The highest level of pica was observed during the no interaction

condition, indicating that the behavior was probably not maintained by social reinforcement. To identify the maintaining reinforcer, the authors could have either systematically examined the effects of a variety of alternative sources of reinforcement (e.g., toys or edible items) on pica, or directly manipulated stimulus characteristics of the pica stimuli. The latter, direct analysis could be conducted using the methodology proposed by Mace and Knight (1986) simply by holding constant the amount of social interaction and level of protective equipment used, while systematically manipulating stimulus characteristics of the pica stimuli in an attempt to identify the behavior's specific maintaining reinforcer.

Although the Favell et al. (1982) and Mace and Knight (1986) studies illustrated preliminary methodologies for assessing the reinforcing effects of pica, most research has focused largely on treatment evaluation. Effective elimination or near elimination of pica has been found with the use of mineral supplements (Bugle & Rubin, 1993; Gutelius et al., 1962); continuous free access to alternative sources of reinforcement (Favell et al., 1982; Mace & Knight, 1986); differential reinforcement of alternative behavior (DRA) (Johnson, Hunt, & Siebert, 1994); a variety of punishment procedures such as physical restraint (Singh & Bakker, 1984), timeout (Ausman, Ball & Alexander, 1974), overcorrection (Duker & Nielen, 1993; Mulick, Barbour, Schroeder, & Rojahn, 1980), water mist and aromatic ammonia (Rojahn, McGonigle, Curcio, & Dixon, 1987), and lemon juice and water mist (Paisey & Whitney, 1989); drug therapy (Stewart, 1995); and a combination of procedures including DRA, differential reinforcement of other behavior (DRO), and overcorrection (Finney et al., 1982), and DRA, DRO, timeout, and overcorrection (Kalfus, Fisher-Gross, Marvullo, & Nau, 1987). In this sample of studies, only four (Bugle & Rubin, 1983; Favell et al., 1982; Gutelius et al., 1962; Mace & Knight, 1986) have focused on aspects of

etiology. This emphasis primarily on treatment is also characteristic of research on selective or discriminant forms of pica. The focus of this study will be on one such form, namely, cigarette pica.

Cigarette pica typically involves ingestion of cigarette products to the exclusion of others. In Danford and Huber's (1982) prevalence survey, cigarette pica occurred in approximately 9% of the sample. There are three risk factors associated with cigarette pica. First, chronic ingestion of tobacco may result in oral cancer, gingival recession, and periodontal diseases (Piazza, Hanley, & Fisher, 1996). Second, and of more immediate concern, is exposure to saliva-borne pathogens that may spread communicable diseases, as well as exposure to incidental pathogens (i.e., substances that comes into contact with cigarettes laying on the ground). Third, intestinal blockage may occur as a result of ingestion of large amounts of cigarettes.

There has been a dearth of research focusing on the assessment and treatment of cigarette pica; and, of the four published studies to date (Donnelly & Olczak, 1990; Foxx & Martin, 1975; Matson, Stephens, & Smith, 1978; Piazza et al., 1996), only one (i.e., Piazza et al., 1996) has attempted to identify the behavior's maintaining reinforcer prior to treatment implementation. Foxx and Martin (1975) evaluated the effects of overcorrection as a treatment for the pica of three participants, one of whom exhibited cigarette pica. An A-B (baseline-treatment) design with two one-session baseline reversal probes was used in the study. During baseline, a cigarette butt was placed in an ashtray every 15 minutes, and was replaced if taken, during an 8-hour period each day. During treatment, similar procedures were in effect as in baseline. However, contingent on each occurrence of cigarette pica, the participant engaged in an overcorrection activity, which consisted of oral hygiene training (toothbrushing for 10 minutes), personal hygiene training (handwashing for 10 min), and cleaning ashtrays (10

min). Physical prompting was used to ensure that the participant repeatedly engaged in the required responses of each component of the overcorrection procedure. Results showed that cigarette pica decreased and eventually was eliminated during treatment, whereas responding was elevated during the two, one-session reversals to baseline in which the overcorrection procedure was removed.

Matson et al. (1978) also evaluated the effectiveness of an overcorrection procedure on one participant who exhibited multiple topographies of SIB (hairpulling and cigarette pica). A multiple-baseline design across target behaviors was used. During treatment, the participant engaged in an overcorrecton procedure contingent on each occurrence of cigarette pica, which consisted of oral hygiene training (toothbrushing for 1 minute) and sweeping the floor, emptying trash cans, and cleaning the floor of debris (9 minutes). Thus, procedures used in the study were similar to those used by Foxx and Martin (1975), except that the duration of overcorrection was shorter, and the personal hygiene component was omitted. Results obtained were also similar to and supported those reported by Foxx and Martin (1975) in that overcorrection was effective in decreasing both target behaviors.

Donnelly and Olczak (1990) examined the effectiveness of a DRA procedure on ingestion of placebo pica stimuli. Due to potential risks involved in using actual cigarettes throughout the course of the study, the authors decided to use placebo stimuli that shared certain stimulus properties of cigarettes but were safe for consumption. The placebo stimuli were manufactured simply by removing a 2-3 cm portion from the crust of a slice of white bread, along with a 1 cm layer of bread (Donnelly & Olczak, 1994). The bread was then rolled and compressed into a cylinder approximately 1 cm in diameter, flattened, and one end singed with a lighter. The appearance of the final product resembled that of a cigarette

butt. The DRA procedure consisted of reinforcing an alternative response (gum chewing) with coffee and was shown to be effective. However, the major limitation of the study was that the dependent variable was not cigarette pica (i.e., no cigarettes were consumed at any time during the study). Hence, it cannot be assumed that the DRA procedure would produce similar effects on cigarette pica because it is unclear if the programmed reinforcer (coffee) could have competed with pica in the presence of actual cigarette products.

Piazza et al. (1996) conducted a case study on the assessment and treatment of cigarette pica for one participant, which included an attempt to identify factors responsible for behavioral maintenance. The study consisted of three assessment and two treatment phases. Phase 1 of the study was conducted to assess the effects of tobacco on cigarette butt ingestion and consisted of two conditions. In each condition, eight unsmoked cigarette butts containing the filter and 0.6 cm of either herbs (herbal butts condition) or tobacco (tobacco butts condition) were distributed throughout the session room and were freely available to the participant. Results showed that the rate of ingestion was higher in the tobacco butts condition than in the herbal butts condition, suggesting that tobacco was an important determinant of cigarette pica.

Phase 2 of the study was designed to identify preferred components of tobacco butts. A choice assessment (Fisher et al., 1992) was conducted in which an unsmoked tobacco butt (0.6 cm of tobacco plus filter), an unsmoked herbal butt (0.6 cm of herbs plus filter), tobacco (0.6 cm of tobacco removed from the cigarette butt), herbs (0.6 cm of herbs removed from the cigarette butt), and cigarette paper (0.6 cm of cigarette paper without tobacco or herbs) were presented to the participant in pairs. The participant was only allowed to select one of the two available stimuli per trial. Each stimulus was presented three times with every other stimulus in a random order, yielding a total of 30 paired

presentations. Results indicated that tobacco was the stimulus that was selected on most trials, suggesting that it was the specific reinforcer responsible for behavioral maintenance.

Phase 3 involved the use of a functional analysis, the procedures of which were similar to those first described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). In that study, four experimental conditions were designed to assess functional relationships between self-injurious behavior (SIB) and specific reinforcement contingencies among nine participants with developmental disabilities. The social disapproval condition investigated the possibility that SIB was maintained by contingent attention. At the outset of the session, the experimenter directed the individual to play with toys and then engaged in a work activity that necessitated minimal interaction with the individual. Statements of concern and disapproval were provided contingent on SIB, and an increased rate of SIB during this condition would suggest that responding was maintained by attention. During the demand condition, the experimenter presented a series of tasks to the individual and, contingent upon SIB, briefly terminated the instructional sequence. An increased rate of responding during this condition would suggest that SIB was maintained by negative reinforcement in the form of escape from tasks. During the alone condition, the individual was placed in a room devoid of any materials that might serve as external sources of reinforcement; in effect, the situation simulated a barren environment. An increased rate of responding during this condition would suggest that SIB was maintained by automatic reinforcement. During the unstructured play condition, no demands were placed on the participant, toys were freely available, and attention was provided on an FT 30 s schedule. This condition served as a control because the delivery of reinforcers on either a continuous (toys, and escape from tasks) or FT (attention) basis would

ensure that functional relationships between the target response and reinforcement contingencies would not be established. In the Piazza et al. (1996) study, there were two procedural differences during the functional analysis. First, the demand condition was not conducted. Second, in order to provide the opportunity for cigarette pica to occur, cigarette butts were available throughout the other conditions. Results indicated that responding was highest during the alone condition and was at or near zero during the social disapproval and unstructured play conditions, suggesting that cigarette pica was maintained by automatic reinforcement.

Treatment evaluation was conducted in Phases 4 and 5. In Phase 4, the authors compared the effectiveness of noncontingent food (NCF) condition with or without response interruption (Interruption). During baseline, tobacco butts and play materials were available, and no social interaction was provided as the participant was alone in the room. During the NCF condition, preferred edible items were made freely available throughout the session, and no consequences were delivered by the experimenter following occurrences of cigarette pica. During the NCF plus Interruption condition, preferred edible items again were made freely available, and verbal reprimands accompanied by response interruption was delivered contingent on tobacco butt pick-ups (i.e., attempts at cigarette pica) and cigarette pica. Results indicated that rates of butt pick-ups and cigarette pica were elevated in baseline and in the NCF condition. Cigarette pica was completely suppressed in the NCF plus Interruption condition, whereas the rate of butt pick-ups was suppressed markedly compared to baseline and the NCF condition, although not completely eliminated. These results suggested that NCF plus Interruption was effective, but that if left unsupervised, the participant likely would engage in cigarette pica. During Phase 5, the authors conducted a stimulus control procedure (i.e., using a specific color card with

which to associate procedures of the NCR plus Interrupt condition) to program and assess generalization of treatment effects. Results suggested that the treatment effects generalized in the absence of staff supervision in a variety of settings.

The major contribution of the Piazza et al. (1996) study is the use of a multicomponent assessment to identify the general reinforcement contingency (automatic reinforcement) and the specific reinforcer (tobacco) maintaining cigarette pica. A second contribution is that, based on results of assessment, a nonintrusive treatment was designed and found to be effective under experimental conditions, which generalized under naturalistic conditions. However, in addition to these notable contributions, there are three limitations. First, because only one individual participated in the study, the extent to which similar effects would be observed across more participants is unclear. Second, smoked tobacco butts, which likely would be the more common stimulus ingested by those who engage in cigarette pica, were not included in the preference assessment with cigarette components. Third, the schedule of food delivery during both NCF conditions was unspecified; if a dense schedule of noncontingent food was used, this may render the procedure impractical under naturalistic conditions (i.e., it is unknown if treatment effects would maintain under leaner schedules).

Thus, of the four studies focusing on cigarette pica, the Donnelly & Olczak (1990) study provided no treatment data on actual cigarette pica. In the remaining three studies, a total of three participants received treatment, only one of whom underwent an assessment to identify the maintaining reinforcer for pica. Thus, the purpose of this study was to conduct a more thorough evaluation of the role of behavioral assessment in developing treatment for cigarette pica,

and to demonstrate treatment effects with actual cigarette pica across several individuals to evaluate generality of intervention.

METHOD

Participants and Setting

Four individuals participated. All participants lived in a state residential facility for persons with developmental disabilities and were referred to a day treatment program for the assessment and treatment of their cigarette pica. Rob, a 40-year-old male, was diagnosed with profound mental retardation, was ambulatory, occasionally responded to one- or two-word requests, displayed no expressive language, and was not receiving any psychotropic medications during the course of the experiment. Helen, a 49-year-old female, was diagnosed with severe mental retardation, was ambulatory, complied with multiple requests, displayed echolalia but also could use functional words in a sentence within a limited context (e.g., "Can I have coffee?"), and was receiving 25mg of Mellaril® BID. Andy, a 44-year-old male, was diagnosed with profound mental retardation, was ambulatory, responded frequently to one- or two-word requests, displayed no expressive language, and was receiving 50mg Mellaril® BID as well as a prescribed medication to control seizures. Larry, a 46-year-old male, was diagnosed with profound mental retardation, was ambulatory, was visually impaired, responded occasionally to one- or two-word requests, and was receiving 100mg Mellaril® BID.

All sessions were conducted either in therapy rooms located at the day program, or outside on the grounds immediately adjacent to either the day program or the participants' residences or worksites. Session times varied in length depending on the condition implemented, and two to eight sessions were conducted per day, at least four days per week. Also present in each room were

a table and at least one chair, as well as materials specific to various conditions of the experiment.

Experimental Design and Procedures

A pretreatment functional analysis (Iwata et al. 1982/1994) to identify functional relationships between environmental stimuli and cigarette pica was not conducted based on staff reports and informal observations during the admission screening process that all participants were observed to engage in cigarette pica when alone or unsupervised. Thus, it appeared unlikely that cigarette pica was maintained by social reinforcement. In essence, the underlying assumption made during the course of the experiment was that cigarette pica was maintained by direct access to cigarette products.

Thus, the experiment was designed to identify the specific reinforcer responsible for behavioral maintenance and to evaluate treatment effectiveness on pica in three phases. Phase 1 consisted of three stimulus preference assessments, which were designed to determine preference for cigarette components, edible items or leisure materials (toys), and preferred cigarette components or preferred edible items. Phase 2 consisted of an evaluation of two treatment procedures, noncontingent reinforcement (NCR) and DRA. Baseline and treatment conditions were conducted in a multiple baseline design (Baer, Wolf, & Risley, 1968) for Rob, Helen, and Andy. A reversal design was used for Larry. Phase 3 consisted of programming and assessing the extent to which treatment effects generalized under naturalistic conditions. In order to ensure that the participants would not be placed at significant risk, the medical staff of the residential facility determined that a maximum of two whole cigarettes could be ingested per day during sessions at the day treatment program.

Stimulus Preference Assessments

There were three purposes for assessing preference. First, given the assumption that cigarette pica was maintained by automatic reinforcement, a related assumption was that some stimulus characteristic of the cigarette was the specific maintaining reinforcer. That being the case, one purpose was to identify the reinforcing component of the cigarette. The second purpose was to identify potential alternative stimuli that might be used during treatment to compete with the target behavior. The third purpose was to determine if a preferred alternative stimulus would actually compete with the reinforcing component of the cigarette when both were concurrently available. If so, delivery of the alternative stimulus on either a noncontingent or contingent basis might suppress pica. Three separate preference assessments were conducted in a sequential fashion to determine, respectively, preference for: (a) cigarette components; (b) edible items or toys; and (b) preferred cigarette components or preferred edible items.

Interobserver Agreement for Stimulus Preference Assessments

Interobserver agreement was assessed for a proportion of the data by having a second observer simultaneously but independently collect data with the primary observer. An agreement was defined as both observers having scored the same selection or no selection in the same trial. Percentage agreement on item selection was calculated by dividing the number of trials containing scoring agreements by the total number of trials in the session. During the cigarette component preference assessment, agreement was assessed during 1 of 3 (33.3%) of Helen's sessions with an agreement score of 100%. During the edible items or toys preference assessment, agreement was assessed for 2 of 5 (40%) of sessions for each participant. Agreement scores for Helen, Andy and Larry were always 100%; the mean agreement score for Rob was 97.6% (range of 95.2% to 100%).

During the preferred cigarette component versus preferred edible item preference assessment, agreement was assessed during 1 of 2 (50%) sessions for both Andy and Larry, and scores never deviated from 100%.

Cigarette Component Preference Assessment

During this condition, preference for three cigarette (Marlboro Lights 100's®) components was assessed: an unsmoked filter, an unsmoked cigarette, and a smoked cigarette butt. The unsmoked filter contained only the filter portion of the cigarette (approximately 3 cm in length) devoid of tobacco. Each unsmoked filter was divided into equal portions, each approximately 1 cm in length (henceforth, the term "unsmoked filter" will be used to refer to each 1 cm unsmoked filter component of the cigarette). The unsmoked cigarette (approximately 6.5 cm in length) contained the tobacco-portion of the cigarette encased in paper minus the filter. Each unsmoked cigarette was divided into 5 equal portions, each approximately 1.3 cm in length (henceforth, the term "unsmoked cigarette" will be used to refer to the 1.3 cm portion of tobacco encased in paper). To ensure that smoked cigarette butts were free of saliva-borne and incidental pathogens, cigarette butts were manufactured in the following manner. A needleless syringe (10 ml or 20 ml capacity) was inserted into the filter portion of an ignited cigarette, and cigarette smoke containing combusted tobacco (nicotine) was drawn through the filter by the action of the upward and downward motion of the plunger of the syringe. The resulting "smoked" cigarette butt measured approximately 1.2 cm after the manufacturing process and was divided into three equal portions of approximately 0.4 cm (henceforth, the term "cigarette butt" will be used to refer to each 0.4 cm syringe-smoked portion of the cigarette). In order to comply with the limit of 2 whole cigarettes consumed per day, sessions were terminated following the ingestion of

an amount of a cigarette component that was equivalent to 2 whole cigarettes (i.e., 6 unsmoked filters, 10 unsmoked cigarettes, or 6 cigarette butts).

Preference for cigarette components was assessed in a paired presentation format described by Fisher et al. (1992) in which the participant was allowed access only to one of two concurrently available cigarette components. Each cigarette component was presented six times with the other two cigarette components in a random order, yielding a total of 18 paired presentations (one paired presentation per trial). A session consisted of six trials, and between one and two sessions were conducted per day, depending on when the limit of cigarette ingestion was attained. Thus, the cigarette component assessment was completed within three days. Prior to the beginning of the first session, participants were given a sample of each cigarette component. For each trial, two different cigarette components were placed approximately 30 cm apart from each other and 20 cm in front of the participant. An approach response to a cigarette component resulted in access to that stimulus and removal of the unselected cigarette component. If no approach responses occurred within 5 s, the experimenter prompted the participant to sample (i.e., pick up and ingest) each stimulus, then the same two stimuli were replaced in front of the participant for 5 s. If approach responses then occurred, they resulted in access to the selected stimulus and removal of the unselected stimulus, whereas no approaches resulted in removal of both stimuli and initiation of the next trial.

Edible Item or Toy Preference Assessment

The purpose of this assessment was to identify participants' preference for food/drink items or toys. The assessment was conducted using a multiple-stimulus format described by DeLeon and Iwata (1996) for Helen, Andy, and Larry. A paired presentation format similar to the one described during the cigarette component preference assessment was used for Rob except seven items

were assessed, and each stimulus was paired once with every other stimulus, yielding a total of 21 paired presentations. Five sessions were conducted for all participants. Prior to the beginning of the first session, participants were given a sample of each item. Each session began with an array of items (n = 7) sequenced randomly along a straight line on a table, approximately 5 cm apart. While a participant was seated approximately 0.3 m from the stimuli, the experimenter instructed the participant to select one item. After an item was selected, it was not replaced. Prior to the next trial, the sequence of the remaining items was rotated by taking the item on the left end of the line and moving it to the right end, then shifting the items to ensure again that they were equally spaced apart. The second trial then began immediately. This procedure continued until all items were selected or until no selection was made within 30 s from the beginning of a trial.

Preferred Cigarette Component Versus Preferred Edible Item/Toy Preference Assessment

Based on results of the previous phases, a third assessment was conducted to determine preference between the cigarette component and edible item or toy (alternative stimulus) that were most frequently selected in previous preference assessments. Preference for the alternative stimulus over cigarettes may suggest that use of the alternative stimulus during treatment may be effective in competing with the target behavior. The procedures used during this phase were similar to those of Phase 1, except that only two stimuli (a cigarette component and an alternative stimulus) were used. The number of paired presentations ranged from 20 (Helen, Andy, and Larry) to 30 (Rob). In addition, preference between unsmoked cigarettes coated with a distasteful substance (Scorned Woman Hot Sauce®, henceforth called "spiked" cigarettes) and the

most preferred food item was assessed for Larry using similar procedures just described across 30 trials.

Results and Discussion of Stimulus Preference Assessments

Table 1 shows the results of the cigarette component preference assessment. Rob, Helen, and Larry selected the unsmoked cigarette most often (100% of trials for Rob and Helen, and 91.7% for Larry). Preference was not as marked for Andy, although he selected the cigarette butt (66.7%) more often than he selected either the unsmoked filter (50.0%) or the unsmoked cigarette (33.3%). Thus, the results indicated that Rob, Helen, and Larry preferred unsmoked cigarettes, whereas Andy preferred cigarette butts.

Table 2 shows the results of the edible item and toy preference assessment. During the assessment, Rob selected M & M® candy during 100% of trials during which it was available, which represented a slight preference relative to the cookie (83.3%) and more so relative to the remaining items. Helen selected coffee 100% of trials during which it was available, which represented a marked preference over the remaining items. By contrast, Andy showed only a slight preference for sliced beets (45.5%) over plain crackers (41.7%) and Larry showed a slight preference for Kit Kat® candy (45.5%) over pudding (41.7%). Thus, the preference assessment identified an edible item as preferred relative to other edible items and toys, but the absolute level of preference was highest only for Rob and Helen and moderate for Andy and Larry.

Table 3 shows the results of the preferred cigarette component versus the preferred edible item preference assessment. Rob selected the edible item on 83.3% of trials and he selected the cigarette component on 16.7% of trials, Helen selected the edible item on 80.0% of trials and she selected the cigarette component on 20.0% of trials, and Andy selected the edible item on 95.0% of trials and selected the cigarette component on 5.0% of trials. By contrast, Larry

Table 1 - Results of Cigarette Component Preference Assessment

Participant	% Trials Selected		
	Unsmoked Filter	Unsmoked Cigarette	Cigarette Butt
Rob	0	100	33.3
Helen	0	100	50.0
Andy	50.0	33.3	66.7
Larry	0	91.7	58.3

Table 2 - Results of Edible Item or Toy Preference Assessment

	% Trials Selected			
Item	Rob	Helen	Andy	Larry
M & M®	100	--	33.3	--
Cookie	83.3	--	--	--
Pretzel	56.7	--	21.7	22.7
Coffee	46.7	100	--	11.4
Sliced Beets	43.3	14.7	45.5	--
Vibrator	13.3	--	--	--
Koosh Ball®	6.7	--	12.5	--
Diet Coke®	--	41.7	--	31.3
Cheese Cracker	--	31.3	--	--
Pudding	--	25.0	--	41.7
Spree®	--	21.7	--	--
Jello	--	16.7	--	--
Plain Cracker	--	--	41.7	--
Juice	--	--	35.7	--
Bead Necklace	--	--	8.8	--
PB & Cheese Cracker	--	--	--	25.0
Kit Kat®	--	--	--	45.5
Skittles®	--	--	--	20.8

Table 3 - Results of Cigarette Component vs. Edible Item Preference Assessment

Participant	% Trials Selected		% Trials Selected	
	Preferred Cigarette Component	Preferred Edible Item	"Spiked" Cigarette	Preferred Edible Item
Rob	16.7	83.3	--	--
Helen	20.0	80.0	--	--
Andy	5.0	95.0	--	--
Larry	95.0	5.0	36.7	63.3

selected the cigarette component on 95.0% of trials and selected the edible item on 5.0% of trials. Thus, 3 of the 4 participants showed marked preference for the preferred edible item versus the preferred cigarette component. Because Larry selected the preferred cigarette component more often than he selected the preferred edible item, another assessment was conducted to see if stimulus characteristics of the cigarette component could be altered such that the edible item may be preferred; this was the basis for assessing preference between spiked cigarettes and the preferred edible item. Results indicated that Larry selected the edible item on 63.3% of trials and selected the spiked cigarette on 36.7% of trials. Although the difference in preference between the preferred edible item and spiked cigarette was smaller than that observed between the preferred edible item and unaltered cigarette component for the other participants, Larry's data suggested that the edible item may compete with spiked cigarettes.

Treatment

Response Measurement and Interobserver Agreement

Cigarette pica was defined as placement of a cigarette product into the mouth past the plane of the upper and lower lips. Due to the restriction on the number of cigarette products that could be ingested, a measure of cigarette pica based on frequency would not accurately reflect participants' free operant rate of responding. Thus, latency to the first response was used as the dependent measure of cigarette pica throughout the study. Data were also collected on two additional participant responses, ingestion of food and independent exchanges of cigarettes for food (correct exchanges), as well as on three experimenter responses: delivery of food or the aversive stimulus, physical prompts, and response interruption. Frequency of experimenter and participant behaviors, with the exception of cigarette pica, was recorded on a hand-held computer

(Assistant, Model AST 102) during continuous 10 s intervals. A counter was used to record the total number of trials elapsed during the DRA training phase. Frequency of correct exchanges was converted to percentage of trials during which responding occurred, and was calculated by dividing the number of trials containing correct exchanges by the total number of trials.

Interobserver agreement was assessed by having a second observer simultaneously but independently collect data with the first observer. Percentage agreement on cigarette pica was calculated by dividing the number of sessions during which both observers' latency measures fell within a plus or minus 1 s window of each other by the total number of sessions in which agreement were collected. Percentage agreement for all other responses was calculated by dividing the number of intervals containing scoring agreements by the total number of intervals in the session. The percentage of sessions during which agreement was assessed for each participant ranged from 17.9% to 45.0%, and the mean percentage agreement across participants ranged from 82.5% to 100%. Individual agreement scores are presented in Table 4.

Baseline

The participant was brought into the therapy room and sat at or stood beside a table. There were no other materials in the room. The experimenter placed a "cigarette" (defined as the preferred cigarette component from the previous assessment) on the table but did not otherwise interact with the participant during the session. Thus, the baseline sessions were similar to those of the alone condition as described by Iwata et al. (1982/1994). An observer started a timer when the cigarette was placed on the table and stopped the timer when cigarette pica occurred. If cigarette pica did not occur prior to 300 s (5 min), the timer was stopped, the cigarette was removed, and the session was terminated. Thus, the criterion for the absence of cigarette pica was arbitrarily set at 300 s during which

Table 4 - Interobserver Agreement

Participant	Cigarette Pica			Correct Exchange		
	% of Sessions Assessed	(% Agreement)		% of Sessions Assessed	(% Agreement)	
		Range	Mean		Range	Mean
Rob	33.3	--	100	28.1	82.5 - 100	93.1
Helen	44.7	85.7 - 100	99.7	45.0	88.4 - 100	92.9
Andy	29.9	--	100	17.9	95.0 - 100	95.9
Larry	35.6	--	100	35.0	96.4 - 100	99.4

the response did not occur.

Noncontingent Reinforcement with Edible Item (NCR [edible item])

The effects of noncontingent reinforcement (NCR) with an edible item as a treatment procedure was evaluated. The purpose for conducting this procedure was to evaluate the effects of a dense schedule of free access to the preferred edible item on cigarette pica. Data from two recent studies (Fischer, Iwata, & Mazaleski, 1997; Lalli, Casey, & Kates, 1997) suggested that noncontingent delivery of reinforcement (i.e., NCR) was effective in suppressing the target behaviors even when contingent reinforcement was provided for the target behaviors. In the Fischer et al. (1997) study, the alternative reinforcer (food) was delivered on a fixed time (FT) 10 s schedule, while each occurrence of the target behavior produced access to the maintaining reinforcer. Results indicated that the target behavior decreased markedly compared to baseline, suggesting that even if ongoing reinforcement for the target behavior was not disrupted, noncontingent or response-independent (i.e., time-based) delivery of alternative reinforcers at a dense schedule was effective in producing response decrement. In the Lalli et al. (1997) study, one participant was exposed to NCR without extinction, in which the maintaining reinforcer was delivered independent of the occurrence of the target behavior (NCR) and contingent on each occurrence of the target behavior (without extinction). The results showed that the target behavior was decreased markedly compared to baseline and eventually was eliminated during this condition. Thus, both the Fischer et al. (1997) and Lalli et al. (1997) studies provided support that delivery of a reinforcer in an NCR procedure may effectively compete with contingent reinforcement for the target behavior. These results provide the basis for examining whether delivery of the preferred edible item would effectively compete with cigarette pica when the

cigarette component was available (i.e., contingent reinforcement for the target behavior).

Procedures for the NCR (edible item) condition were as follows. The preferred edible item was delivered on an FT 10 s schedule for five minutes prior to the start of the session (presession). At the end of 5 min, the session began (as in baseline) when the experimenter placed the cigarette on the table. The FT 10 s delivery of the edible item continued throughout the session. If pica did not occur, the session was terminated after 300 s. If pica did occur, the session was terminated, but the experimenter continued to deliver food for an additional 60 s. The latter procedure avoided the possibility of inadvertently introducing a contingency in which the edible item was no longer forthcoming following cigarette pica. An observer started the timer as soon as the cigarette was placed on the table and stopped it when pica occurred or was absent for 300 s. The criterion for successful treatment was absence of pica for 300 s for 5 consecutive sessions.

For subjects for whom a dense NCR schedule with the edible item was effective in deterring the occurrence of pica for 300 s, a schedule thinning procedure was implemented to examine whether leaner schedules could maintain treatment effects produced by dense NCR schedules and, if so, may be a practical treatment to implement under naturalistic conditions. The procedures used were similar to those of the NCR (edible item) condition, except that schedule thinning occurred following cigarette availability. The method of schedule thinning was based on the mean latency to cigarette pica during separate probe sessions. During these probes, the cigarette was not available for five minutes while food was delivered on an FT 10 s schedule. Then, the cigarette was placed on the table and food no longer was forthcoming. The initial NCR schedule was set at 75% of the mean latency to cigarette pica during

the probe sessions. This schedule remained in effect for the first three sessions. During the fourth and subsequent sessions, the NCR schedule was set at 75% of the mean latency to responding during the previous three sessions. A restriction was imposed while setting all NCR schedules such that the value of each schedule would not exceed that of the previous schedule by more than 25%. This limitation was to ensure a gradual schedule thinning process. The criterion for successful treatment was absence of pica for 300 s for 5 consecutive sessions.

DRA plus Response Interruption

Because results of the preferred cigarette component versus preferred edible item preference assessment suggested that food or drink items were preferred over cigarettes, there was reason to believe that delivery of the more potent reinforcer contingent on an alternative response may compete effectively with cigarette pica. A response interruption procedure was added as a supplement to the DRA procedure in order to enhance the latter's potential treatment effects. That is, results of the cigarette versus edible item preference assessment did not indicate exclusive preference for the alternative reinforcer, indicating that there was a low probability that cigarette pica may occur during treatment involving the alternative reinforcer. Thus, in order to ensure that that potential reinforcement as result of engaging in cigarette pica would not compete with access to the alternative reinforcer during the DRA procedure, the response interruption procedure was added to prevent occurrence of cigarette pica. Each session consisted of 20 training trials and a final test trial. During each training trial, the experimenter placed the cigarette on the table, extended his or her hand, palm facing upwards, a few inches above and to the side of the cigarette, and instructed the participant to hand the cigarette to the experimenter in exchange for the edible item (i.e., reinforcement was delivered for engaging in the correct exchange, which was the alternative response). If no response occurred within

10 s, the experimenter repeated the instruction and modeled the alternative response. If no response occurred within 10 s, the experimenter repeated the instruction and physically prompted the participant to engage in the alternative response. Reinforcement was only delivered when the participant engaged in the alternative response without a physical prompt. If a cigarette pica attempt occurred, which was defined as picking up and bringing the cigarette within 6 inches of the participant's mouth, the experimenter prevented the participant from ingesting the cigarette by placing the experimenter's hand between the cigarette and the mouth, and removing the cigarette from the participant's hand. The experimenter then repeated the instruction, and physically prompted the participant to engage in the alternative response.

The purpose of the test trial was to determine if reinforcement with an edible item for independently turning in the cigarette (i.e., without prompting or interrupting a pica attempt) would be effective in deterring cigarette pica. During the test trial, the cigarette was placed on the table. No prompts were delivered other than the experimenter extending his or her hand out to allow the opportunity for the participant to independently engage in the alternative response. The edible item was delivered if the alternative response occurred independently, but pica was not prevented. The criterion for success was five consecutive test trials in which either a correct exchange occurred in each test trial, or the absence of cigarette pica for the 300 s prior to each test trial. The common goal of deterring pica prior to 300 s could be achieved by fulfilling either criterion.

Generalization

In order to determine if treatment would be effective under naturalistic conditions, generalization of treatment effects was programmed and assessed across two different parameters (setting and experimenter) during three phases.

In all phases, procedures similar to those just described for the DRA plus response interruption condition were used. During Phase 1, generalization was programmed by having a novel experimenter (T2) implement the DRA training trials in a novel therapy room (S2) in the day treatment program. Generalization of treatment effects was assessed during the subsequent test trial. During Phase 2, a novel experimenter (T3) implemented the same procedures outside but close to the vicinity of the day treatment program (S3). During Phase 3, various novel therapists implemented the procedure in a variety of settings (varied S/T), such as outside the grounds of the participants' residences and worksites. The criterion for completing each phase was five consecutive test trials in which either a correct exchange occurred in each test trial, or if cigarette pica was absent prior to 300 s in each test trial.

Additional Procedures for Larry

Results of Larry's preferred cigarette component versus preferred edible item preference assessment showed a preference for cigarettes, suggesting that a DRA procedure identical to that used for the other participants was unlikely to be effective. However, it was possible that a noncontingent schedule of food presentation (NCR [edible item]) might suppress pica by producing a general satiation effect. Thus, Larry was exposed to a series of NCR conditions, followed by DRA conditions in which the preferred cigarette component was altered. Other participants were not exposed to the series of NCR and DRA conditions, or the final procedure (satiation).

NCR. Dense schedules of NCR (FT 10 s) were used throughout this phase with a variety of stimuli. Following the NCR (edible item) condition, the stimuli used were herbal cigarettes and nicotine-based products, which represented safer alternatives to pathogen-laden cigarettes. In the NCR (herbal cigarettes) condition, the filter of each herbal cigarette was removed and the remainder

divided into 8 equal pieces (each approximately 0.7cm in length). The herbal cigarettes, which primarily contained marshmallow and herbs (clover, rose, and coltsfoot), were delivered on an FT 30 s schedule for 5 minutes prior to the start of the session. During the session, an FT 30 s schedule was used instead of a denser schedule (e.g., FT 10 s) because anecdotal observations indicated that it took approximately 30 s for Larry to chew each herbal cigarette. The session started when the experimenter placed a cigarette on the table. Subsequent to cigarette availability, the schedule of delivery of herbal cigarette continued until 300 s had elapsed or until 60 s following the occurrence of cigarette pica.

Following this condition, several nicotine-based products were delivered to determine if free access to alternative sources of nicotine could compete effectively with cigarette pica. In other words, perhaps free access to the maximum allowable amount of the maintaining reinforcer may be sufficient to satiate Larry from engaging in cigarette pica to obtain additional amounts of nicotine by eliminating the apparent establishing operation (Michael, 1982) for cigarette pica. During the NCR (nicotine pouch) condition, one pouch [Skoal]® was given to Larry to chew for 30 s prior to cigarette availability. No additional nicotine pouches were given following cigarette availability. During the NCR (nicotine gum) condition, one piece of Nicorette® gum (2 mg) was given to Larry 30 seconds prior to cigarette availability. No additional nicotine gum was given following cigarette availability. In a subsequent phase, a piece of nicotine gum was provided 30 minutes prior to cigarette availability. The 30 min presession delay was based on information provided by the manufacturer indicating that peak levels of nicotine absorption are reached 30 min after chewing the gum. Following cigarette availability, Nicorette® was no longer delivered.

DRA (edible item) and spiked cigarettes. Although results of the preference assessment showed preference for the cigarette component over the edible item,

results also indicated preference for the edible item over spiked cigarettes. Thus, it was possible that the alternative response (exchanging the cigarette component for the edible item) could be initially shaped by using spiked cigarettes and that the response might maintain when unaltered cigarettes were later introduced. During this phase, each cigarette was coated ("spiked") with approximately 1 ml of Scorned Woman Hot Sauce®. Each session consisted of 20 training trials and a subsequent test trial. During each training trial, the experimenter placed the spiked cigarette on the table, extended his or her hand, palm facing upwards, a few inches above and to the side of the cigarette, and instructed Larry to hand the spiked cigarette to the experimenter in exchange for the edible item. If no response occurred within 10 s, the experimenter repeated the instruction and modeled the alternative response. If no response occurred within 10 s, the experimenter repeated the instruction and physically prompted Larry to engage in the alternative response. Reinforcement was delivered only when Larry engaged in the alternative response without a physical prompt. There were no consequences on pica attempts (i.e., a response interruption procedure was not added because it was thought that DRA in combination with distasteful cigarettes would be sufficient to deter pica). During the test trial, the spiked cigarette was placed on the table. No prompts were delivered other than the experimenter extending his or her hand out to allow Larry the opportunity to engage in the alternative response. There was no consequence for pica. Reinforcement was delivered contingent on the alternative response.

DRA + response interruption + overcorrection. Procedures used were similar to those described in the DRA (edible item) plus spiked cigarettes condition except that, contingent on each pica attempt: (a) the response was blocked; and (b) an overcorrection procedure was implemented, which consisted of the

experimenter physically prompting Larry to repeatedly hand the cigarette to the experimenter for 5 min.

DRA + response interruption + water mist. Procedures used were similar to those during DRA + response interruption + overcorrection condition, except that a water mist procedure was used in lieu of overcorrection. During the water mist procedure, contingent on each occurrence of cigarette pica, the experimenter held a plant sprayer filled with room temperature water approximately 6 inches from Larry's face and, with the sprayer set on spray mode, sprayed Larry once.

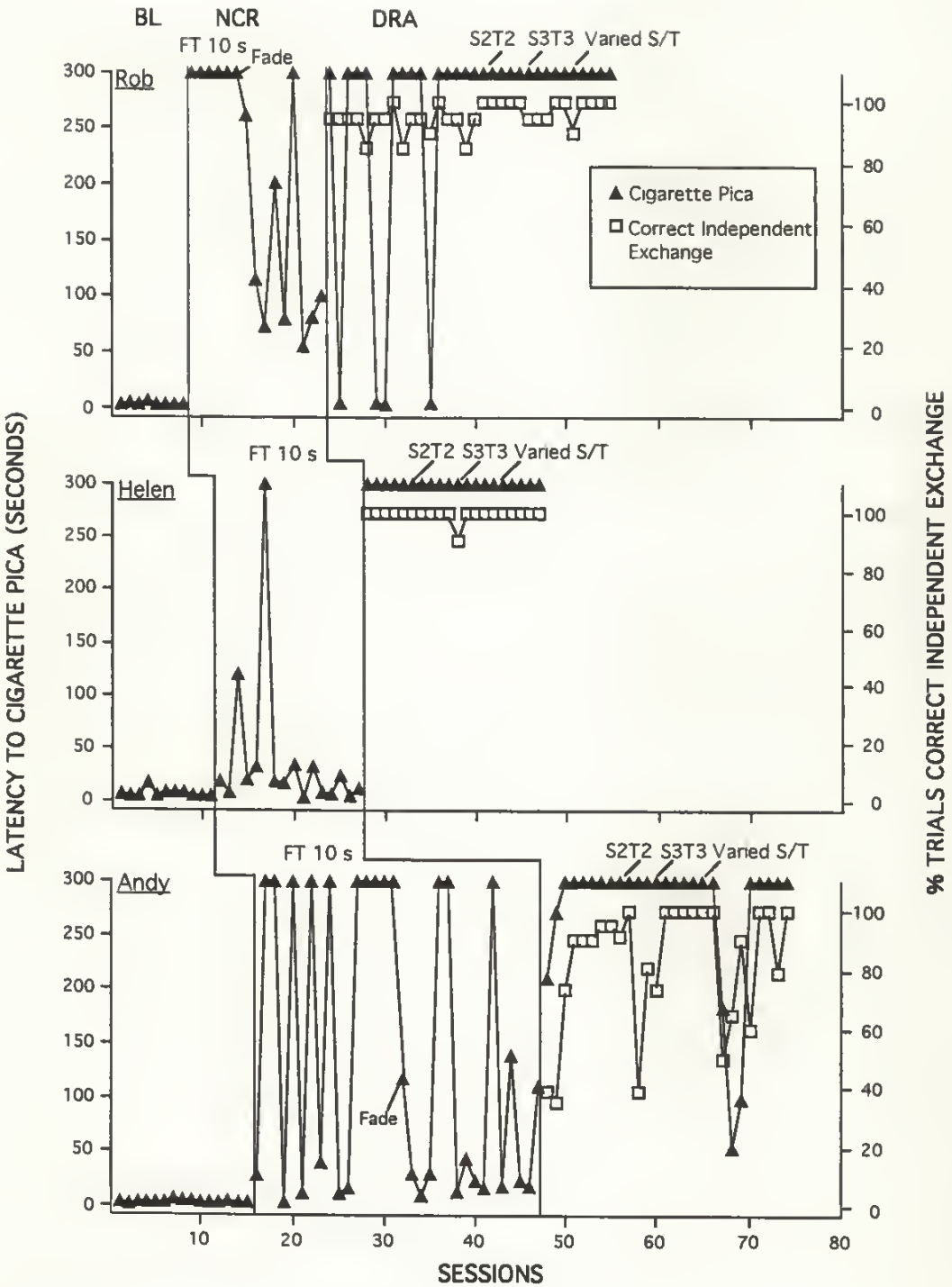
DRA + response block + hot sauce (in mouth). The only procedural difference between this phase and that of the DRA + response interruption + water mist condition was that, contingent on each pica attempt, the experimenter squirted 2 ml of Scorned Woman Hot Sauce® into Larry's mouth.

Satiation. The rationale for this procedure was that ingestion of a large number of distasteful cigarettes might deter cigarette pica. The procedure consisted of coating 9 unsmoked cigarettes (one short of the maximum daily intake) with Scorned Woman Hot Sauce® and giving them to Larry five minutes prior to cigarette availability. At the end of 5 min, the 10th cigarette (unaltered) was placed on the table.

RESULTS AND DISCUSSION

Figure 1 shows the results for Rob (top panel), Helen (middle panel), and Andy (bottom panel). Rob engaged in cigarette pica at very short latencies during baseline (mean = 3.3 s). During NCR (edible item) at FT 10 s schedules, Rob met the criterion for completion at the outset of treatment as pica did not occur for 300 s for the first five sessions. During schedule thinning, the pattern of responding was variable. There were only two sessions in which pica was absent for 300 s (session #14, during which the NCR schedule was FT 148 s; and session #20, during which the NCR schedule was FT 88 s), so Rob did not meet criterion for successful completion of treatment. Two responses were measured in the DRA plus response interruption condition: (a) correct exchanges during the training trials; and (b) latency to cigarette pica during the test trials (a correct exchange during a test trial was scored as absence of pica for 300 s). Rob's data during DRA indicated that for the first 12 sessions in this phase, he inconsistently abstained from ingesting the cigarette until reaching the 5-session criteria with the first experimenter in the original training room. The pattern of correct exchanges was more stable throughout, and occurred at a fairly high percentage of trials (mean = 93.5%). During generalization, Rob's data indicated that correct exchanges occurred during a high percentage of the training trials (mean = 98.2%), and the pattern of responding was stable throughout generalization. His data also indicated that cigarette pica did not occur at all during any of the test trials.

Figure 1. Latency to cigarette pica (seconds) and percentage of trials of correct exchange (during training trials) for Rob, Helen, and Andy.


BL
NCR
DRA
FT 10 s
Fade
S2T2 S3T3 Varied S/T
Rob
Helen
Andy
Cigarette Pica
Correct Independent Exchange
LATENCY TO CIGARETTE PICA (SECONDS)
% TRIALS CORRECT INDEPENDENT EXCHANGE
SESSIONS

Helen also showed very short latencies to cigarette pica (mean = 6.9 s) during baseline. During the NCR (edible item) condition, when the schedule was FT 10 s, latencies to responding generally were rather short (mean = 40.6 s). Although the latencies increased somewhat, pica was absent for only one session; thus, Helen failed to meet criterion for completion of treatment. Consequently, schedule thinning was not implemented. There was no reason to believe that lean schedules of NCR would be effective in deterring pica if a dense schedule failed to compete with the behavior. During DRA + response interruption, Helen took the minimum number of sessions to meet criterion for successful completion of treatment (i.e., cigarette pica never occurred for 300 s in each of the first five sessions). She engaged in correct exchanges during 100% of the training trials. During generalization, the same pattern of responding occurred in that she met criterion for successful completion of each phase of generalization with the minimum number of sessions, and engaged in correct exchange 100% in all but one session (91%) (mean = 99.4%).

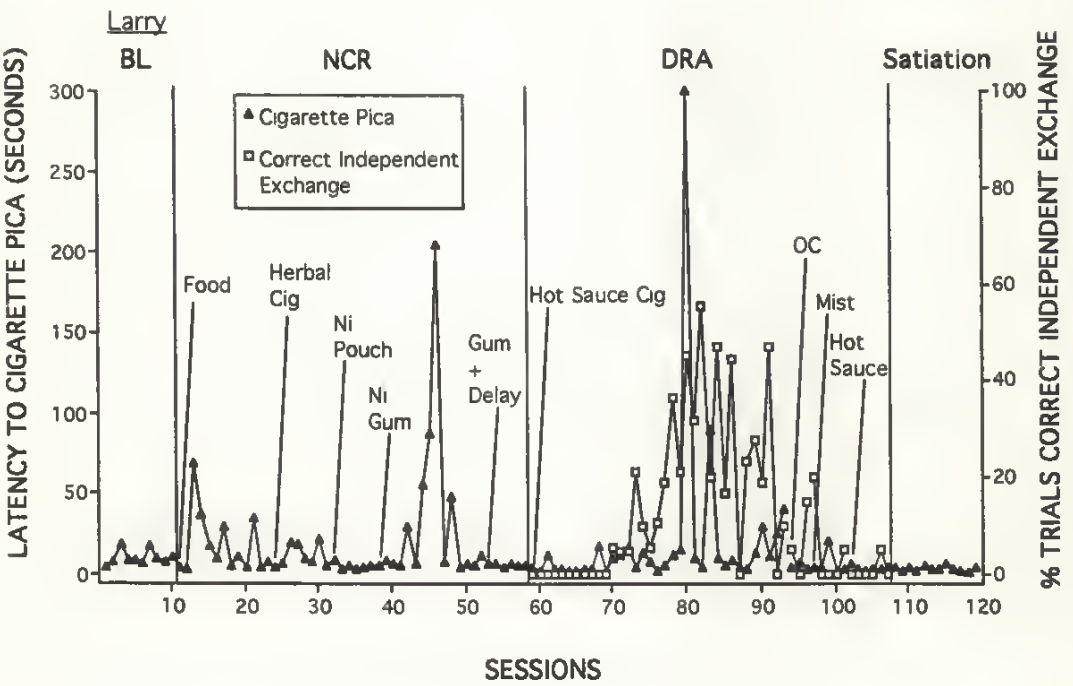
Andy showed short latencies to pica during baseline (mean = 4.3 s). During NCR (edible item) at an FT 10 s schedule, the pattern of responding was extremely variable (sessions #16 - #26) before criterion for treatment completion was met during the subsequent five sessions. During schedule thinning, the pattern of responding once again became variable. There were only three sessions in which pica was absent for 300 s (session #36, NCR schedule = FT 18 s; session #37, NCR schedule = FT 22 s; and session #42, NCR schedule = FT 21 s), so he also did not meet criterion for completion of treatment. During DRA + response interruption, his data showed that the percentage of trials with correct exchange during the first two sessions was relatively low compared to those of the next five sessions; furthermore, cigarette pica occurred prior to 300 s in the first two trials but was absent in the subsequent five trials. During

generalization, the pattern of correct exchanges was variable but the overall level was fairly high (mean = 86.6%). His data also indicated that cigarette pica was absent for 300 s during the test trials for the first two phases (S2T2 and S3T3) of generalization. However, during the varied S/T phase, pica occurred before 300 s during sessions 67 through 69. Nevertheless, Andy met criterion for successful completion of generalization as pica was absent for five consecutive test trials during the final five sessions of the varied S/T phase.

Figure 2 shows the results of treatment for Larry. During baseline, Larry's pica occurred at relatively short latencies (mean = 10 s). During the NCR (edible item) condition, the pattern of responding was a little more variable than it was during baseline, but his mean latency to pica only reached 18.5 s. Similar results were obtained for the remaining NCR conditions. The mean latencies to pica during the various NCR conditions were as follows: 16.6 s (herbal cigarettes), 4.5 s (nicotine pouch), 34.6 s (nicotine gum), and 5.8 s (nicotine gum, 30 min delay), indicating that NCR with a variety of alternative stimuli, including nicotine-based products, did not deter pica.

During the DRA + distasteful substance procedure, although an increasing trend in correct exchange was seen towards the middle half of the phase, a similar trend was not observed for latency to cigarette pica. Additionally, cigarette pica was absent in only 1 of 42 sessions and the mean latency to the behavior was 20.3 s. Hence, the results indicated that DRA with spiked cigarettes was ineffective. The mean latencies to pica during the final three DRA procedures were as follows: 5.1 s (DRA + response interruption + overcorrection), 3.6s (DRA + response interruption + water mist), and 3.2 s (DRA + response interruption + distasteful substance squirted into the mouth). The mean latency to cigarette pica during the satiation procedure was 3.2 s. The mean

Figure 2. Latency to cigarette pica (seconds) and percentage of trials of correct exchange (during training trials) for Larry.


Larry
BL
NCR
DRA
Satiation
Cigarette Pica
Correct Independent Exchange
Food
Herbal Cig
Ni Pouch
Ni Gum
Gum + Delay
Hot Sauce Cig
OC
Mist
Hot Sauce
LATENCY TO CIGARETTE PICA (SECONDS)
% TRIALS CORRECT INDEPENDENT EXCHANGE
SESSIONS
0
50
100
150
200
250
300
20
40
60
80
100
10
20
30
40
50
60
70
80
90
100
110
120

latencies during the last four phases of treatment were shorter than that of baseline, indicating that those procedures were ineffective.

Thus, in summary, the data showed that NCR (edible item) at a dense schedule was an effective procedure for Rob and Andy; however, thinning the schedule of NCR did not maintain initial treatment effects. The implication of these results is that a practical NCR procedure (i.e., one designed to be implemented under naturalistic conditions) was not feasible. On the other hand, DRA proved to be effective for Rob, Helen, and Andy; furthermore, treatment effects were obtained quickly for Helen and Andy. Results of the generalization phase showed that treatment effects successfully generalized across multiple experimenters and multiple settings for Rob, Helen, and Andy. Finally, staff were trained to implement the DRA procedure.

By contrast, none of the 10 treatment procedures was successful in reducing Larry's cigarette pica. Although more intrusive forms of punishment than those used in the study may have been more effective, these procedures were not evaluated because the severity of the behavior problem did not seem to warrant such interventions. Therefore, Larry was regarded as a treatment failure, and further attempts to eliminate pica using contingencies of reinforcement and punishment were abandoned. Instead, supervision procedures were implemented to minimize occurrences of cigarette pica. Briefly, these procedures consisted of having staff continually keep Larry within view and in close proximity such that pica attempts could be blocked, and having staff frequently clean the area surrounding Larry for cigarette products.

GENERAL DISCUSSION

The purpose of this study was to evaluate a systematic methodology for the assessment and treatment of cigarette pica, a topic that has received scant attention in the applied literature. The methodology consisted of a series of stimulus preference assessments, interventions based on the outcome of those assessments, and generalization of treatment effects. The preference assessments identified the preferred cigarette component, competing reinforcers, and effective assessment-based treatments for three of four participants.

A noteworthy feature missing from the study was an attempt to rule out the role of social consequences as possible maintaining reinforcers. A pretreatment functional analysis was not conducted because there were no data suggesting that cigarette pica was maintained by social reinforcement. Additionally, all participants were observed to engage in pica when alone, suggesting that the behavior was maintained by automatic reinforcement. Thus, the approach taken was to assess cigarette components that were preferred, as well as alternative reinforcers that might effectively compete with pica. However, it is remotely possible that cigarette pica might be maintained by social reinforcement, and additional research is needed to determine the extent to which this is observed. One way to gather evidence for or against the contribution of social consequences would be to simply conduct a functional analysis of cigarette pica similar to that used by Piazza et al. (1996).

Several limitations, in addition to the absence of a general functional analysis of cigarette pica, should also be noted. First, one of the interventions (NCR) was not a practical treatment procedure and, as a result, the range of effective

procedures that can be used to eliminate cigarette pica was limited. In other words, the data indicated that infrequent delivery of small amounts edible items would not be effective under experimental conditions, thus there was reason to believe that treatment also would not be effective under naturalistic conditions. Second, although DRA was effective, the alternative response (exchanging cigarettes for the alternative reinforcer) shares some topographical features with the target response (cigarette pica). Thus, the initial part of the behavioral chain leading to pica was maintained, and in the absence of consistent reinforcement by experimenters, pica may be more likely to recur. Third, extensive attempts to develop a treatment program, including the use of nicotine-based reinforcers and the use of punishment contingencies produced no suppression of Larry's pica.

There are several noteworthy features of the study. First, the dependent variable measured was actual cigarette pica, which was identical to that measured in the Foxx and Martin (1975), Matson et al. (1978) and Piazza et al. (1996) studies but contrasts with that measured in the Donnelly and Olczak (1990) study. Second, measures were taken to minimize health risks associated with ingestion of cigarettes. This was conducted by limiting the number of cigarettes ingested per day, using latency to provide a sensitive measure of pica given that the frequency of cigarette ingestion was limited, and using syringes to manufacture cigarette butts that were relatively free of saliva-borne and incidental pathogens. The use of a latency measure and the manufacturing process both are novel to the assessment and treatment of cigarette pica. Third, the assessment procedures were useful in identifying the preferred component of the cigarette responsible for cigarette pica, as well as indicating preference for preferred edible items over preferred cigarettes. In essence, the results of the stimulus preference assessments provided the basis for developing the NCR and DRA interventions. More generally, the cigarette component preference

assessment used in the present experiment and in the Piazza et al. (1996) study involved a direct modification of stimulus characteristics of pica objects. Such a methodology has not been conducted in previous research on pica and also represents an extension of the indirect methodology proposed by Favell et al. (1982) and Mace & Knight (1986) in their attempts to identify the behavior's maintaining reinforcer. Finally, a systematic implementation of the DRA procedure across multiple experimental settings provided a means of generalizing treatment effects.

One avenue for future research would be to identify other components of a cigarette that make its ingestion reinforcing. The methodology used to identify the preferred cigarette component yielded three distinct stimulus characteristics of the cigarette and preference was identified for two of those features (unsmoked cigarettes and cigarette butts). However, it is likely that additional stimulus features of the cigarette may be responsible for cigarette pica that were not identified in the experiment. Specifically, unsmoked filters, unsmoked cigarettes, and cigarette butts differ along several dimensions such as taste, texture, presence or absence of nicotine, shape, and size to name a few. Of these possible stimulus characteristics, taste and nicotine appear to be the more likely relevant maintaining reinforcers as they are unique to cigarettes. In order to determine if taste is the relevant stimulus characteristic, one would simply have to conduct a preference assessment between two stimuli: the preferred cigarette component, and the preferred cigarette component with modifications made only to the taste feature of that cigarette component. Preference for the preferred cigarette component would suggest that taste may be the relevant stimulus characteristic maintaining cigarette pica. It would be difficult to determine if nicotine, which is present in both unsmoked cigarettes and cigarette butts, maintained cigarette pica. The most direct method to investigate this hypothesis

would be to conduct a preference assessment between the preferred cigarette component and a similar cigarette component devoid of nicotine. Preference for the cigarette component would implicate nicotine as the maintaining reinforcer. However, at the present time, nicotine-free tobacco cigarettes are not yet available (Piazza et al., 1996).

A second avenue for future research would be to examine further manipulations with NCR in an attempt to identify conditions under which it may be effective in eliminating pica. It may be the case that a longer duration of noncontingent access to edible items at a dense schedule may prove effective in deterring pica. In other words, perhaps the 5 min presession NCR procedure with edible items was insufficient to remove the behavior's establishing operation such that the participant would still be motivated to engage in cigarette pica. There is some evidence suggesting that providing an overabundance of reinforcers (i.e., reinforcer satiation procedures) at a level far exceeding baseline levels can produce rapid elimination of the target behavior. For example, Rast, Johnston, Drum, and Conrin (1981) found that providing food that exceeded the baseline breakfast quantity by 5-8 times and the baseline lunch quantity by 3-6 times eliminated rumination; however, delivery of food quantity twice that of baseline levels produced no effect. Thus, one way to examine the effects of reinforcer satiation on cigarette pica would be to allow the participant free access to edible items until consumption ceased for some time period, suggesting that satiation was achieved. Subsequently, a cigarette would then be made available and the absence of pica would suggest treatment effectiveness.

A third avenue for future research would be to examine the basis of treatment failure in Larry's case in an attempt to arrive at an effective intervention for his cigarette pica. Based on results of the preferred cigarette component versus preferred edible item preference assessment, altering the stimulus characteristics

of the cigarette to shift preference in favor of food did not yield an effective intervention. That is, although there was some degree of preference for the edible item over the spiked cigarette, a DRA procedure involving exchanging the spiked cigarette for the edible item was ineffective. This may suggest that the consequence of the distasteful cigarettes likely were insufficient to override the reinforcing effects produced by cigarette pica. If so, other means of altering the stimulus characteristics of the cigarette may be needed to produce aversive consequences sufficient to override the reinforcing consequences of cigarette pica. Specifically, it may be possible to add chemicals to the cigarette such that ingestion of a small amount may be sufficient to produce acute adverse physiological reactions (i.e., vomiting) without causing physical harm but sufficient to suppress cigarette pica. However, the rationale for conducting such an intrusive procedure should first involve an evaluation of the severity of cigarette pica. If the potential for physical harm is great should cigarette pica remain untreated, and if punishment procedures pose no risk of physical harm, then perhaps the use of more intrusive interventions similar to that just described may be used.

Whereas other topographies of SIB have been the subject of extensive inquiry, research on the assessment and treatment of cigarette pica appears to be in its developmental stages. This study has illustrated a methodology highlighting the vital role of assessment in the treatment of cigarette pica, as well as the importance of evaluating generality of treatment effects. Undoubtedly, several limitations of the study are noted and may well serve as areas for future research. Thus, applied researchers should continue to refine the methodology described in the study to gain a more thorough understanding of etiological factors of cigarette pica such that the behavior can be rapidly, consistently, and effectively eliminated.

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BIOGRAPHICAL SKETCH

Han-Leong Goh graduated from the University of Pennsylvania with a B.A. in psychology in May 1990. Mr. Goh was first exposed to behavior analysis while working as a clinical specialist at the Children's Seashore House in Philadelphia. As a direct consequence of his work experience, he enrolled at the University of Florida in the Fall of 1992 to work with Dr. Brian Iwata in order that he may further his professional career in applied behavior analysis. For the past five years, he has been working as a graduate research assistant at the Florida Center on Self-Injury under the supervision of Dr. Iwata where Mr. Goh was involved in research projects on the assessment and treatment of self-injurious behavior (SIB). Mr. Goh is expected to receive his Ph.D. in Fall of 1997 and is about to commence employment as a postdoctoral fellow at the Kennedy Krieger Institute of the Johns Hopkins University School of Medicine, where he will continue research in the assessment and treatment of severe behavior disorders.

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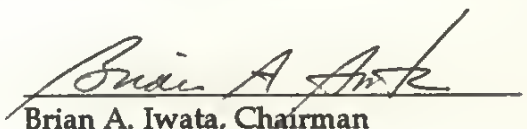

Brian A. Iwata, Chairman
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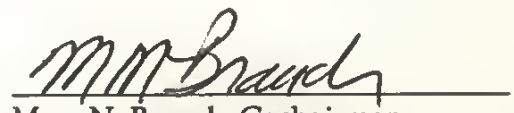

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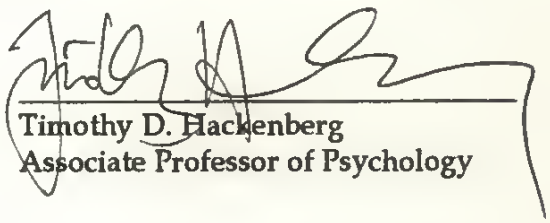

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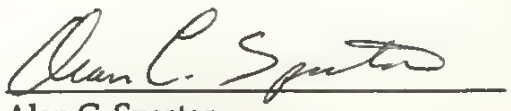

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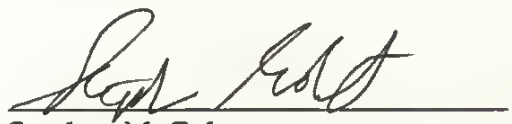

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This dissertation was submitted to the Graduate Faculty of the Department of Psychology in the College of Liberal Arts and Sciences and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December 1997

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